SYSTEMS AND METHODS FOR FACILITATING USER ACCESS TO CONTENT STORED ON PRIVATE NETWORKS

FIELD OF THE INVENTION

The present invention relates generally to computer networks and, more particularly, to systems and methods for storing and retrieving resources on computer networks.

BACKGROUND OF THE INVENTION

Increasingly, people are gathering large amounts of digital media content (hereinafter "content"), including music files, image files, video files, etc. For example, music files in formats such as MP3 are increasingly available for download via the Internet. Audio players such as Winamp allow users to store, retrieve and play MP3 files. Various other audio players are available for audio files of different formats. Similarly, the use of digital cameras has increased dramatically and many users are storing video files and images taken via their digital cameras on their personal computers. Video players and image viewers are available that allow users to store, retrieve and display video and image files of various formats.

Unfortunately, storing, organizing, and using digital media content, particularly when large numbers of media content files exist, can be difficult. Accordingly, there is a need for improved ways of storing, organizing,

and using digital media content.

Increasingly, existing homes and homes under construction are being "networked" wherein communications cables (video, data, and/or telecommunications cables) are being extended to many rooms and, in some cases, to multiple locations within each room. Currently, devices are networked in the home via technologies such as, Ethernet, wireless, phone-line networking, and power-line networking. Phone-line networking allows PCs and other devices to be networked by plugging them into phone jacks, while power-line networking allows PCs and other devices to communicate through electrical outlets. One benefit of "home networking" includes the ability to network multiple computers and share multimedia content throughout the home. For example, using an audio player like Winamp on a device, a user can play an MP3 file located on another device connected to a home network.

Unfortunately, conventional home networks and other private networks may not allow users to remotely access and play content stored within devices connected thereto. For example, conventional home networks may not allow users to launch Winamp on devices external to the home network and play MP3 files stored on devices connected to a home network. Accordingly, there is a need for facilitating remote user access to content stored on machines connected to a private network, such as a home network.

SUMMARY OF THE INVENTION

In view of the above discussion, systems and methods that facilitate user access to various types of content stored within one or more devices on a private network, both from other devices on the private network and from devices external to the private network, are provided. Content, such as audio files, video files, image files, etc. may be stored within various types of

devices connected to the private network (*e.g.*, personal computers, laptop computers, personal digital assistants, etc.). Content stored within each network device is published to the private network (*e.g.*, to other devices on the private network), either periodically or continuously, via a respective contributor module associated with each network device. Content publishing includes monitoring content stored within a network device and announcing the presence of content stored within a network device to other network devices via a salutation/discovery protocol.

Meta information about content stored within each network device is aggregated, either periodically or continuously, via an aggregator module in communication with each contributor module. The content stored within the network devices is then categorized, either automatically or manually by a user, into one or more content categories via a categorizer module in communication with the aggregator module.

The content stored within the various network devices can be presented to users via one or more user interfaces, such as audio players, video players, image viewers, etc. A user formulates and sends a query for content to the aggregator module via a user interface. The results of the query to the aggregator module are returned to the requesting user interface from the aggregator module and displayed. Content selected from the displayed query results by a user is then retrieved from wherever it is stored on the private network. Prior to delivery to a requesting user, content may be tailored and/or reformatted to be compatible with a requesting user interface by one or more contributor modules.

The type of category into which content is arranged is dependent on the given content format. For example, audio and video content may be arranged into "channels" of content, such that a user can request

delivery of a channel of content in lieu of individual
content files.

According to embodiments of the present
invention, a gateway may be provided on a private network
5   that allows users to securely access content (e.g.,
individual files and/or "channels" of content) from
outside the private network. The gateway has an IP
address that is valid on the Internet and permits
communications between selected external devices and
10   devices on the private network.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of a content
management system according to embodiments of the present
15   invention.

Fig. 2 is a block diagram of a content
management system according to additional embodiments of
the present invention.

Figs. 3-5 are flowchart illustrations of
20   methods, apparatus (systems) and computer program
products, according to embodiments of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention now is described more
fully hereinafter with reference to the accompanying
25   drawings, in which embodiments of the invention are
shown. This invention may, however, be embodied in many
different forms and should not be construed as limited to
the embodiments set forth herein; rather, these
embodiments are provided so that this disclosure will be
30   thorough and complete, and will fully convey the scope of
the invention to those skilled in the art. Like numbers
refer to like elements throughout the description of the
drawings.

35   As will be appreciated by one of skill in the
art, the present invention may be embodied as methods and

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data processing systems. Accordingly, the present invention may take the form of an entirely hardware embodiment, an entirely software embodiment or an embodiment combining software and hardware aspects.

5   Computer program code for carrying out operations of the various modules of the present invention may be written in an object oriented programming language such as JAVA®, Smalltalk or C++. Computer program code for carrying out operations of the various modules of the present invention may also be written in conventional procedural programming languages, such as "C", or in various other programming languages. Software embodiments of the present invention do not depend on implementation with a particular programming language. In addition, portions of computer program code may execute entirely on one or more data processing systems.

The present invention is described below with reference to block diagram and flowchart illustrations of methods and systems according to embodiments of the present invention. It is understood that each block of the block diagram and flowchart illustrations, and combinations of blocks in the block diagram and flowchart illustrations, can be implemented by computer program instructions. These computer program instructions may be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer or other programmable data processing apparatus, create means for implementing the functions specified in the block diagram and flowchart block or blocks.

These computer program instructions may also be stored in a computer-readable memory that can direct a computer or other programmable data processing apparatus to function in a particular manner, such that the

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instructions stored in the computer-readable memory
produce an article of manufacture including instruction
means which implement the function specified in the block
diagram and flowchart block or blocks.

5   The computer program instructions may also be
loaded onto a computer or other programmable data
processing apparatus to cause a series of operational
steps to be performed on the computer or other
programmable apparatus to produce a computer implemented

10   process such that the instructions which execute on the
computer or other programmable apparatus provide steps
for implementing the functions specified in the block
diagram and flowchart block or blocks.

        It should be noted that, in some alternative

15   embodiments of the present invention, the functions noted
in the flowchart blocks may occur out of the order noted
in the flowcharts. For example, two blocks shown in
succession may in fact be executed substantially
concurrently or the blocks may sometimes be executed in

20   the reverse order, depending on the functionality
involved. Furthermore, in certain embodiments of the
present invention, such as object oriented programming
embodiments, the sequential nature of the flowcharts may
be replaced with an object model such that operations

25   and/or functions may be performed in parallel or
sequentially.

        Fig. 1 is a schematic diagram of a content
management system **10** according to embodiments of the
present invention. A plurality of devices **12** (*e.g.*,

30   personal computers, laptop computers, personal digital
assistants, etc.) are connected to a private network **14**
(*e.g.*, a home network, an enterprise network, etc.) and
have various types of content stored in local storage **16**.
The network devices **12** may be connected to the private

35   network **14** via various technologies including, but not
limited to, Ethernet, wireless, phone-line networking,

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and/or power-line networking. The illustrated private network **14** is isolated from the Internet **60** by a gateway **18**.

Each network device **12** in the illustrated content management system **10** includes software executing thereon referred to as a contributor module **20** that is configured to monitor local data storage of the respective network device **12** for various types of content and to "publish" or announce the presence of locally stored content, as well as changes to content, to other network devices **12** via a salutation/discovery protocol. Each contributor module **20** may be configured to continuously or periodically scan the local data storage of a respective network device. According to embodiments of the present invention, users can restrict the types of files and/or the directories/sub-directories of files that can be monitored and published. For example, a user may not want certain types of files published such as temporary files. A user may not want files within directories such as "temporary internet files" or "cache" published.

For example, when a user downloads an MP3 file from the Internet and stores the file locally on a network device **12**, the contributor module **20** for the respective network device **12** detects the new file and publishes the existence of the new file to the other network devices **12**. Exemplary salutation/discovery protocols that may be utilized to publish content in accordance with embodiments of the present invention include Universal Plug and Play (UPnP; www.upnp.org), Jini™ (www.jini.org), Salutation (www.salutation.org), etc. When content is stored within a network device, a salutation/discovery protocol (*e.g.*, UPnP, Jini™, Salutation, etc.) allows the contributor module to announce the presence of the content to other devices on

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the network, along with information about the content
(e.g., meta information). UPnP, Jini™, and Salutation are
well known to those skilled in this art and need not be
discussed further herein.

As used herein, the term "content" means any
type of resource available for storage and retrieval via
a computer including, but not limited to, audio content
(e.g., MP3 format files, AVI format files, WAV format
files, WMA format files, streaming audio, etc.); video
content (e.g., MPG format files, QuickTime format files,
streaming video, etc.); image content (e.g., JPEG format
files, GIF format files, TIFF format files, etc.);
electronic books (e.g., "eBooks"); text files, etc. Each
contributor module 20 may be configured to scan and
detect one or more types of content.

The illustrated content management system 10
also includes a network device 24 having software
executing thereon referred to as an aggregator module 30
that is configured to obtain and store content meta
information (i.e., descriptive information about content)
from each contributor module 20 about content stored
within each respective network device 12. The aggregator
module 30 stores content meta information within one or
more databases, indicated as 32. The aggregator module 30
may monitor each contributor module 20 on a continuous or
periodic basis.

In the illustrated embodiment of **Fig. 1**,
content is stored locally on the various network devices
12 and only content meta information is aggregated and
stored by the aggregator module 30. A content management
system 10' according to an alternative embodiment of the
present invention is illustrated in **Fig. 2** and includes
an aggregator module 30 that is configured to aggregate
and store both content and content meta information. In
Fig. 2, content stored by the aggregator module 30 is

stored in one or more databases, indicated as **34**.

The illustrated network device **24** in **Figs. 1-2**
also includes software executing thereon referred to as a
categorizer module **40** that is configured to communicate
5   with the aggregator module **30** and to use content meta
information stored by the aggregator module **30** to arrange
the content stored within the network devices into one or
more content categories based upon the content itself,
and/or based upon stored rules **41** for the user. The type
10   of category into which content is arranged is dependent
on the given content format and upon stored rules (*e.g.*,
user identification, preferences, etc.). For example,
there may be thousands of music files (*e.g.*, MP3 files)
stored in the various network devices **12** for which the
15   aggregator module **30** has obtained and stored meta
information therefor. The categorizer module **40** can
utilize the meta information for these MP3 files to
create one or more music channels. For example, the
categorizer module may be able to categorize all jazz MP3
20   files into a "jazz channel" thereby allowing a user to
specify via a user interface that he/she wishes to listen
to "jazz." Rules **41** upon which files are categorized
automatically may be updated and/or changed by users,
according to embodiments of the present invention.

25   Content may be arranged into categories
automatically via the categorizer module **40** or a user may
utilize the categorizer module **40** to individually arrange
content into categories, such as channels. For example, a
conventional MP3 file includes meta information in the
30   last thirty characters (referred to as ID3 field) of the
file. The ID3 field typically includes meta information
such as music "genre". Accordingly, music files falling
in the jazz genre may be so identified via the ID3 field.
The categorizer module **40** can be configured to
35   automatically parse an MP3 file and detect various

information from the ID3 field. Alternatively, a user can manually specify to the categorizer module **40** how a particular content file is to be categorized. Certain types of content may not allow automatic categorization via the categorizer module **40**. For example, image files may not contain meta information that a categorizer module can utilize. However, various algorithms may be utilized to categorize content. For example, advanced image analysis techniques may be employed to categorize image files.

The aggregator and categorizer modules **30, 40** may be combined or may be separately executing programs. In addition, the aggregator and categorizer modules **30, 40** may execute on the same or different network devices.

In the illustrated content management system **10** of **Figs. 1-2**, each network device **12** includes an audio player **52**, a video player **54**, and an image viewer **56**, which serve as respective user interfaces associated with respective types of content. Audio players, video players, and image viewers are well known to those skilled in this art and need not be described further herein.

Each user interface (*i.e.*, the audio player **52**, video player **54**, or image viewer **56**) can find the aggregator module **30** via a salutation protocol for content available on the private network **14** in response to a user request, and to display the results of such queries. In addition, each user interface is also configured to retrieve and present content from one or more network devices **12** in response to user selection of displayed query results. According to embodiments of the present invention, a user interface can serve the function of an aggregator module **30**.

For example, a user may open an audio player **52** on a network device **12** and send a query for a listing of

all jazz audio files on the network. The audio player **52**
sends the query to the aggregator module 30 which
searches the stored aggregated meta information **32** and
returns a listing of content that satisfies the query.

5   The user can select one or more files from the displayed
results and the selected content is retrieved by the
audio player **52** from where it is stored on the network **14**
and played to the user. If the particular music file is
stored by the aggregator module **30**, the audio player **52**

10   retrieves the music file from the aggregated content
database **34** (**Fig. 2**).

A user may also make a request to the
aggregator module **30**, via an audio player **52**, to retrieve
and play a channel of content. For example, a user may

15   instruct an audio player **52** to retrieve and play audio
content from the various network devices **12** in response
to user selection of a channel created by the categorizer
module **40**.

Embodiments of the present invention are not

20   limited to the illustrated configurations of **Figs. 1-2**.
Various types and numbers of network devices may be
utilized. Moreover, network devices may be configured
differently. For example, one network device may include
an audio player, but not a video player. Another network

25   device may include only an image viewer, etc.

According to additional embodiments of the
present invention, a contributor module **20** associated
with a network device **12** may be configured to tailor
content requested by a user prior to retrieval by a user

30   interface. The capabilities of various user interfaces to
receive, process, and display content may vary. For
example, if an image file having a size of 1600 x 1200
pixels is requested by an image viewer that can only
display 320 x 240 pixels, the requested image may not be

35   displayed properly, if at all, unless the size of the

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image is tailored from 1600 x 1200 pixels to 320 x 240 pixels. Furthermore, some user interfaces may require content to be in a certain format. For example, an image viewer may not be capable of displaying certain image file types such as JPEG or GIF. Accordingly, a contributor module **20** according to embodiments of the present invention may be configured to change the format (*e.g.*, change an image format from GIF to JPEG) of requested content to suit a requesting user interface prior to retrieval by the user interface.

According to embodiments of the present invention, a contributor module **20** may be configured to tailor and/or reformat content as necessary including, but not limited to, audio content, video content, images, text, etc. Content tailoring and reformatting is understood by those skilled in the art and need not be described further herein.

Embodiments of the present invention may be specifically designed for a particular type of content, such as audio content. For example, according to embodiments of the present invention, an audio content management system that facilitates user access to personal audio content stored on one or more private network devices includes one or more contributor modules associated with respective private network devices, wherein each contributor module continuously monitors audio content stored within a respective network device and announces the presence of the audio content to other network devices. The audio content management system includes an aggregator module that continuously monitors each contributor module and that obtains and stores meta information from each contributor module about audio content stored within each respective network device, as well as changes to audio content stored within each respective network device. In addition, the audio content management module includes a categorizer module that uses

meta information stored by the aggregator module to
arrange the audio content stored within the network
devices into one or more audio channels. An audio player
in communication with the private network (*e.g.*,
executing on a network device) is configured to retrieve
and play audio content from the network devices in
response to user selection of a channel. A gateway
connected to the private network may be provided and is
configured to grant access to audio content stored within
the network devices to authorized users via devices not
connected to the network.

  Similarly, according to embodiments of the
present invention, a video content management system that
facilitates user access to personal video content stored
on one or more private network devices includes one or
more contributor modules associated with respective
private network devices, wherein each contributor module
continuously monitors video content stored within a
respective network device and announces the presence of
the video content to other network devices. The video
content management system includes an aggregator module
that continuously monitors each contributor module and
that obtains and stores meta information from each
contributor module about video content stored within each
respective network device, as well as changes to video
content stored within each respective network device. In
addition, the video content management module includes a
categorizer module that uses meta information stored by
the aggregator module to arrange the video content stored
within the network devices into one or more video
channels. A video player in communication with the
private network (*e.g.*, executing on a network device) is
configured to retrieve and play video content from the
network devices in response to user selection of a
channel. A gateway connected to the private network may
be provided and is configured to grant access to video

content stored within the network devices to authorized
users via devices not connected to the network.

According to embodiments of the present
invention, a gateway **18** may be provided on a private
network **14** that allows users to securely access content
(*e.g.*, individual files and/or "channels" of content)
from outside the private network **14**. The gateway **18** has
an IP address that is valid on the Internet **60** and
permits communications between selected external devices
70 and devices **12** on the private network **14**. A
particularly preferred gateway for use in accordance with
embodiments of the present invention is described in co-
pending, co-assigned U.S. Patent Application, Serial No.
09/874,802, filed June 5, 2001, which is incorporated
herein by reference in its entirety.

Preferably, communications between external
devices and devices on a private network utilize a secure
transmission scheme, such as Secure Sockets Layer (SSL).
SSL is a commonly-used protocol for managing the security
of a message transmission on the Internet, and is well
known to those of skill in the art. A gateway according
to embodiments of the present invention may be configured
to communicate with various types of external devices
such as conventional PC devices, as well as conventional
portable devices, such as PDAs, handheld computers,
and/or Web-enabled phones. A gateway **18** according to
embodiments of the present invention may include various
security features, such as firewalls to prevent strangers
from hacking into a home network, as well as virus
protection. OSGi (Open Service Gateway Initiative) is an
exemplary residential gateway standard that may be
utilized by a gateway **18**.

Figs. 3-5 are flowchart illustrations of
methods, apparatus (systems) and computer program
products, according to embodiments of the invention, that

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facilitate user access to content stored within one or more devices on a private network. Referring initially to **Fig. 3,** content stored within each network device is published to the private network (*e.g.*, to other devices

5   on the private network), either periodically or continuously, via a respective contributor module associated with each network device (Block **100**). Content publishing includes monitoring content stored within a network device (Block **110**, **Fig. 4**) and announcing the

10 presence of content stored within a network device to other network devices (Block **120**, **Fig. 4**).

Meta information about content stored within each network device is aggregated, either periodically or continuously, via an aggregator module in communication

15 with each contributor module (Block **200**). The content stored within the network devices is then categorized, either automatically or manually by a user, into one or more content categories via a categorizer module in communication with the aggregator module (Block **300**). The

20 content stored within the various network devices can be presented to users via one or more user interfaces, such as audio players, video players, image viewers, etc. (Block **400**).

Referring to **Fig. 5,** operations associated with

25 presenting stored content to users via a user interface include sending a query for content available on the private network to the aggregator module via a user interface (*e.g.*, an audio player, video player, image viewer, etc.) (Block **510**). The results of a query to the

30 aggregator module are returned to the requesting user interface from the aggregator module and displayed (Block **520**). Content selected from the displayed query results by a user is then retrieved from wherever it is stored on the private network (Block **530**). Prior to delivery to a

35 requesting user, content may be tailored and/or

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reformatted to be compatible with a requesting user interface by one or more contributor modules (Block **540**).

The foregoing is illustrative of the present invention and is not to be construed as limiting thereof. Although a few exemplary embodiments of this invention have been described, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention as defined in the claims. Therefore, it is to be understood that the foregoing is illustrative of the present invention and is not to be construed as limited to the specific embodiments disclosed, and that modifications to the disclosed embodiments, as well as other embodiments, are intended to be included within the scope of the appended claims. The invention is defined by the following claims, with equivalents of the claims to be included therein.